

different specificities for the NAD/NADH and NADP/NADPH coenzyme couples and so facilitates the transfer of electrons between NAD/NADH and NADP/NADPH couples through said substrates, said transformed microorganism thereby producing from carbohydrate a product more reduced than pyruvate with more benefits than does the corresponding non-transformed microorganism, with said benefits being selected from the group consisting of a cheaper process, a higher specific rate, a higher volumetric rate, a higher yield of product from carbohydrate, and smaller amounts of unwanted side products, and a smaller oxygen requirement.

3 1  
2. (Amended) A microorganism transformed with a recombinant DNA molecule that replaces the natural promoter of a host gene encoding an NAD/NADH- or NADP/NADPH-linked dehydrogenase by another promoter that causes stronger expression or expression under different physiological conditions than said natural promoter and so causes the functional coupling of the oxidation and reduction of substrates by NAD/NADH- or NADP/NADPH-linked dehydrogenase reactions that share a common substrate and have different specificities for the NAD/NADH and NADP/NADPH coenzyme couples and so facilitates the transfer of electrons between NAD/NADH and NADP/NADPH couples through said substrates, said transformed microorganism thereby producing from carbohydrate a product more reduced than pyruvate with more benefits than does

the corresponding non-transformed microorganism with said benefits being selected from the group consisting of a cheaper process, a higher specific rate, a higher volumetric rate, a higher yield of product from carbohydrate, smaller amounts of unwanted side products, and a smaller oxygen requirement.

3. (Amended) The microorganism of claims 1 or 2, said microorganism producing a product faster than does a corresponding non-transformed microorganism.

3/ 4. (Amended) The microorganism of claims 1 or 2, said microorganism producing less CO<sub>2</sub> per unit of a product produced than does a corresponding non-transformed microorganism.

5. (Amended) The microorganism of claims 1 or 2, said microorganism having a reduced oxygen requirement per unit of a product produced than has a corresponding non-transformed microorganism.

6. (Amended) The microorganism of claims 1 or 2, wherein said microorganism produces from carbohydrates a product more reduced than pyruvate while maintaining a higher metabolic capacity to convert carbohydrate into said product than does a corresponding non-transformed microorganism.

7. (Amended) The microorganism of claim 6, wherein the metabolic capacity of a corresponding non-transformed microorganism decreases with time.

8. (Amended) The microorganism of claims 1 or 2, wherein the product is ethanol.

17. (Twice Amended) The microorganism of claims 1 or 2, wherein at least one of the recombinant DNA molecules encodes an NAD/NADH- or NADP/NADPH-linked dehydrogenase or replaces the natural promoter of a host gene encoding an NAD/NADH- or NADP/NADPH-linked dehydrogenase.

19. (Amended) The microorganism of claims 1 or 2, which microorganism is a yeast.

21. (Amended) A microorganism of claim 9, which is a strain of *Saccharomyces* spp. Or *Schizosacharomyces* spp. expressing genes encoding xylose reductase and xylitol dehydrogenase, and which is transformed with at least one recombinant DNA molecule encoding an NAD/NADH- or NADP/NADPH-linked dehydrogenase or replacing the natural promoter of a host gene encoding an NAD/NADH- or NADP/NADPH-linked dehydrogenase.

28. (Twice Amended) A method of producing useful products from carbohydrates, comprising the step of fermenting said materials with a microorganism of claims 1 or 2.

39. (Amended) The microorganism of claims 1 or 2, wherein at least one of the recombinant DNA molecules encodes or causes the expression of a gene encoding a pyruvate carboxylase.

Please add the following new claim:

--40. (New) A microorganism transformed with at least one recombinant DNA expression vector comprising a DNA molecule encoding a gene of at least one enzyme that facilitates the functional coupling of the oxidation and reduction of substrates by NAD/NADH-linked or NADP/NADPH-linked dehydrogenase reactions that share a common substrate and have different specificities for the NAD/NADH and NADP/NADPH coenzyme couples, said transformed microorganism producing one or more products from carbohydrate more efficiently than does a corresponding non-transformed microorganism.--